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Recent spread of the Sida Leafbeetle, *Calligrapha pantherina* Stål, 1859 (Coleoptera: Chrysomelidae: Chrysomelinae) in New Caledonia

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Abstract: We report the recent arrival and subsequent spread of the Sida Leafbeetle, *Calligrapha pantherina* Stål, 1859, in the archipelago of New Caledonia. The species seems to have a rapid spread as it is now recorded all along the west coast and also have spread to the Loyalty Islands. The first specimen was caught in November 2012. This is a biocontrol agent which was introduced in the Pacific Region against invasive Malvaceae (*Sida* spp.). This accidental arrival would help to control the alien weed, *Sida acuta* Burm. f., in New Caledonia. But this establishment raises some questions about potential threats on the two endemic New Caledonian *Sida* species. We also discuss this arrival and subsequent installation in the context of global change and biosecurity issues, particularly in such a biodiversity hotspot.

Key words: biological invasion, biocontrol agent, biosecurity, weed control

In the context of global change and economic globalization (facilitation of populations moving and increase of commodities exchanges between countries), there is an increasing ability to move species to new areas beyond their natural range of distribution. This is a major issue according to further associated disturbances of the so-called invasive species, especially against human economy (Hulme 2009). In the context of spread of agricultural and environmental pests, especially weeds, there is also a parallel extension in the use and transfer of biocontrol agents (BCAs) in order to minimize the use of chemical pesticides and to contribute to a more sound and sustainable pest management. However, transfers of BCAs also contribute to the homogenization of species' distribution worldwide. These alien species movements are of concern especially for island countries where biodiversity issues are high, such as New Caledonia, which is recognized as a world biodiversity hotspot (Myers et al. 2000; Grandcolas et al. 2008; Mille et al. 2012). As already pointed out in the context of New Caledonia, these exotic species can bring major imbalance in both eco- and agro-systems (Beauvais et al. 2006; Jourdan and Mille 2006; Jourdan and Loope 2006). The spread of insect pests is increasingly recorded more accurately in the context of international trade agreements and associated phytosanitary regulations, but records that document the spread of BCAs are much scarcer and should be regarded as 'good news'.

Here, we present the first record and subsequent spread of the Sida Leafbeetle, *Calligrapha pantherina* Stål, 1859, in New Caledonia. This BCA, used against pasture weeds, originated from Central America and has been extensively released in Australia and Western Pacific islands since the 1990s (Flanagan et al. 2000; Heard and Day 2012). The targeted weeds are *Sida* spp., but more specifically *Sida acuta* Burm. f., also called "Broom Weed" or "Spinyhead Sida", as well as against *S. rhombifolia* Linnaeus, called "Common Sida", "Sidratusa" or "Paddy's Lucerne". *Calligrapha pantherina* was introduced and released between September 1989 and March 1992 from Mexico in Australia's Northern Territory (Flanagan et al. 2000). Both adults and larvae of this leafbeetle are able to defoliate *Sida* spp. and subsequently reduce seed production. This beetle was then released in Papua New Guinea in 2000 from an Australian source (Kuniata and Korowi 2004, *in* Heard and Day 2012), followed by Fiji Islands in 2002 with specimens from Papua New Guinea and in 2005 in Vanuatu, with specimens introduced

Figure 1. Living specimen of *Calligrapha pantherina* on its host plant (S. Cazères).

from Fiji (Bule 2009). In Vanuatu, it was first released on Efate Island, but released and found in 2006 on Espiritu Santo (Jolivet et al. 2010a) and Mallicolo Island, and later on most of the archipelago.

Several specimens were collected and then carefully identified using the literature (Stål 1859: 319) and this identification was confirmed by chrysomelid specialists. The first collected specimen was formally identified by its external characters by Dr. Pierre Jolivet (Paris, France), a world renowned leafbeetle specialist who previously examined and detected the species in Vanuatu (Jolivet et al. 2010a). Photos were also sent to Dr. Mauro Daccordi, also a world renowned leafbeetle specialist, for a second confirmation.

All specimens were prepared and pinned before photographing (Figures 1–3) and were deposited in the following two New Caledonian collections: Collection de Référence des Invertébrés Terrestres de Nouvelle-Calédonie – Xavier Montrouzier, IAC (Institut Agronomique néo-Calédonien), Station de Recherches Fruitières de Pocquereux, La Foa, New Caledonia (acronym: CXMNC); and Institut de Recherche pour le Développement Collection, Nouméa, New Caledonia (acronym: ONNC).

Material examined:

Païta, Mont Mou, 22.100044, 166.355719, Pierre Wagner property, leg. C. Mille, 25/XI/2012, deposited in CXMNC, 1 specimen.

Kaala Gomen-Ouégoa, road from Ouhéolle to Paimboas, 20.579695, 164.527106, leg. J.-J. Cassan, 03/IV/13, deposited in ONNC, 1 specimen.

Koumac (Paagoumène), Tiébaghi (Société Le Nickel bureau, Creek-à-Paul Region), alt. 15 m, 20.485857, 164.193886, leg. H. Jourdan,

Figures 2 and 3. *Calligrapha pantherina*. **2:** Dorsal habitus. **3:** Lateral view (S. Cazères).

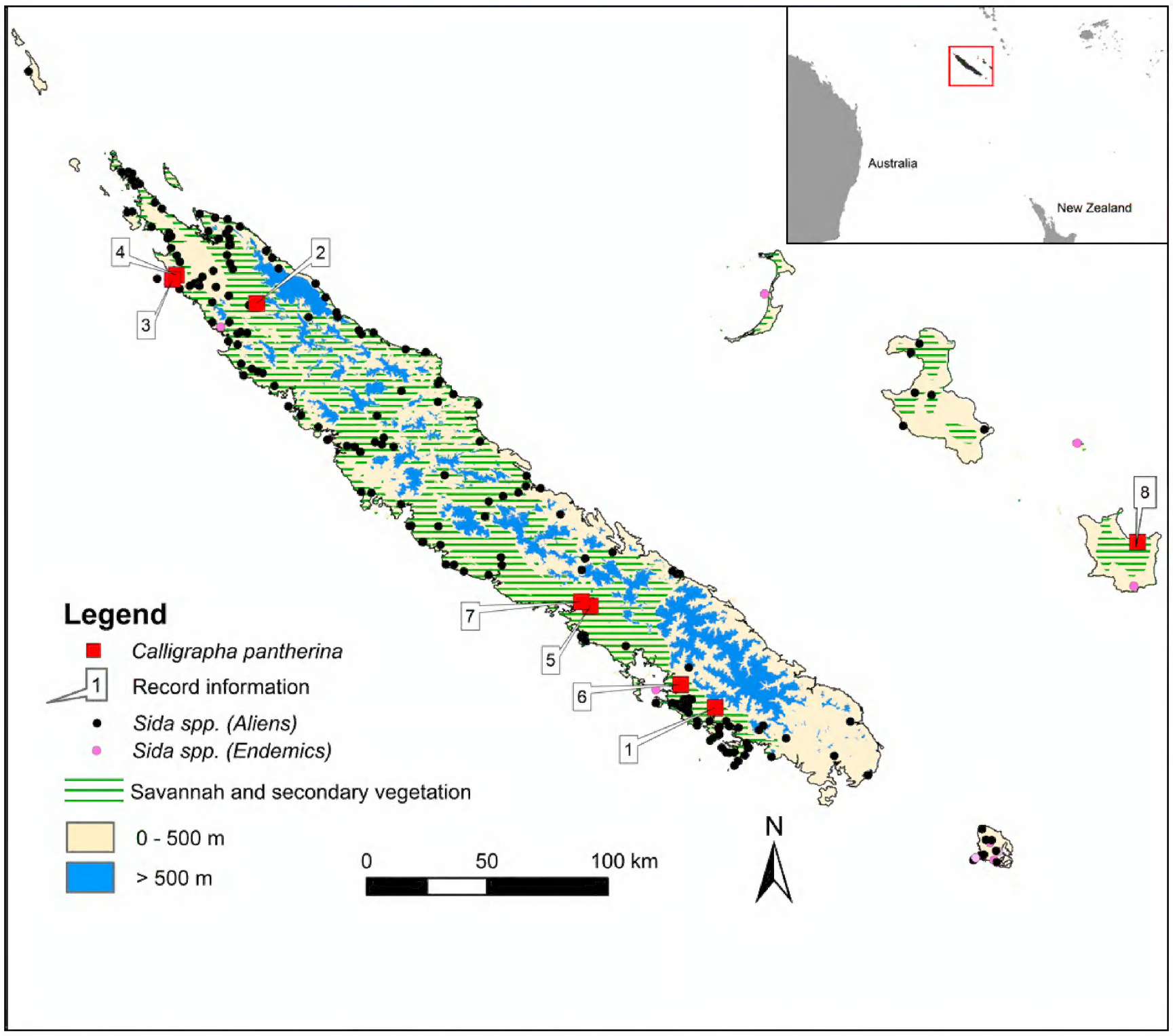

Figure 4. Occurrence of endemic and alien *Sida* spp. and chronologic detection records of *Calligrapha pantherina* Stål, 1859 in New Caledonia.

14–19/V/2013, deposited in CXMNC, 12 specimens.

Koumac, Dome de Tiébaghi (en amont du site Unité de Transformation du Minerai), alt. 480 m, 20.469769, 164.209714, leg. H. Jourdan, 19/V/2013, deposited in CXMNC, 1 specimen.

La Foa, Méaré, 21.720025, 165.854411, leg. R.-M. M'Bouéri, 07/VII/2013, deposited in CXMNC, 1 specimen.

Païta, La Tontouta Airport, 22.013658, 166.217233, leg. G. Manauté and F. Galtat, 07/VIII/2013, 1 specimen, lost by one of us (CM).

La Foa, Nily, alt. 34 m, 21.70408, 165.81785, leg. C. Mille, 25/VIII/2013, deposited in ONNC, 1 specimen.

Maré (Loyalty Islands), La Roche, 21.465667, 168.047417, leg. P. Wadra, 20/III/2014, deposited in CXMNC, 1 specimen.

The first specimen of *C. pantherina* was caught by November 2012 in vicinity of the Mont Mou (Figure 4). This is obviously a recent arrival as its bright green color and patterns (Figure 1) are very distinctive and this beetle would not have been confused with any other known New Caledonian leafbeetle (Jolivet et al. 2010b, 2013) nor with any unrecorded ones in recent introduced species lists (Jourdan and Mille 2006). According to the date of the first record, we can assume that this beetle probably arrived by mid-2012. It is now well established all along the west coast where savannah and pastures are the dominant ecosystems, below elevations of 500 m, on every kind of soil, including on ultramafic ones, where conditions are favorable for the occurrence of *Sida* spp. weeds (Figure 4). The last detection of *C. pantherina* occurred in Maré Island on March 2014, and illustrates a rapid colonization of the archipelago (mainland to Loyalty Islands) in less than 1.5 years.

In New Caledonia, there are 44 introduced Malvaceae, and among them, *Sida cordifolia* and *S. acuta* are of concern. To date, *S. acuta* is considered to be "potentially invasive" because its populations are scattered and only in low densities in New Caledonia (Desmoulins et al. 2012), and *S. cordifolia* appears to be the most common (Desmoulins et al. 2012). Thus, this BCA could prevent any increase of *S. acuta* and even other *Sida* spp. On a wider scale, the status of weeds in New Caledonian biotas is of concern, with 2,008 introduced taxa recorded, of which 200 are considered as invasive or potentially invasive (Hecquet and Le Corre 2010).

Although this leafbeetle is considered a beneficial insect, we can wonder whether the New Caledonian endemics *Sida bipartita* and *S. nummularia* (Jaffré et al. 2004) will not be threatened by further spread of *C. pantherina*. In this matter, the recent spread to Maré

island is a major concern. In some cases, spontaneous arrivals of BCAs have already been shown to be a threat to autochthonous species (Sullivan 2014). But, according to Forno et al. (1992), feeding, survival and oviposition of this species of leafbeetle were sufficiently poor during feeding tests to be acceptable for release in Australia, with greater impacts on and preferences for alien *Sida* spp. than native ones.

The establishment of *C. pantherina* in New Caledonia means that large insects can be moved accidentally and involuntarily introduced to island countries. We know that numerous small species can be spread between islands by wind, and several examples are known in New Caledonia, including *Diachus auratus* (Fabricius, 1801) (Reid 1988), *Heteropsylla cubana* Crawford, 1914 (Chazeau et al. 1990), and more recently *Quadristichus eryhtrinae* Kim, 2004 (Mille and Jourdan unpublished). Nevertheless, *C. pantherina* colonized New Caledonia by this means, as it is a quite large beetle (7 mm long) with limited flying ability (Flanagan et al. 2000). It is capable of flying or being carried by winds over hundreds kilometers over the sea. It is reasonable to think that this species hitchhiked in a ship, or less likely, in a plane. Its recent detection on Maré Island in March 2014 shows that this option is highly probable (Figure 1). Another option could be a large weather event, such as the tropical storm Vania that first reached Vanuatu and then New Caledonia in January 2011 (Météo France 2013). However, this storm was almost two years before the first detection of *C. pantherina*, and it is hard to believe that such a climatic pathway has been involved in the spread of this species, even if such pathways were identified to explain the spread of the dragonfly *Tramea loewii* (Kaup, 1866) (Odonata: Libellulidae) from Australia or New Caledonia to New Zealand (Rowe et al. 2011). The fact that the three inhabited Loyalty Islands of Lifou, Ouvéa and Tiga, despite their closeness to the Vanuatu Archipelago, do not have this beetle is another clue that this storm would not have been involved. Nevertheless, the recent arrival of the beetle on Maré Island illustrates secondary spread within the New Caledonian archipelago. In the context of a lack of any internal quarantine system, this means that whole plants or parts of plants can travel freely between the islands. The spread of this insect to Lifou, Ouvéa and Tiga is very likely in the near future.

Of concern in New Caledonia are biosecurity issues related to (1) the opening of two new pathways (ports of Vavouto in the middle of the Grande Terre and Prony in the south), (2) the increasing imports of commodit ies (mainly with the two large nickel processing plants) and (3) the opening of new airline routes since 2008 (i.e., La Réunion Island and Korea). As already pointed out in the New Caledonian context (Beauvais et al. 2006; Mille et al. 2012), the natural dispersion ability of insects within the region should be also considered as a threat in addition to typical quarantine pathways. It would be also relevant to monitor the New Caledonian endemic *Sida* spp. populations in the next future to check if *C. pantherina* leafbeetles are not a threat to them.

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